California Environmental Protection Agency

Air Resources Board

MEETING NOTICE AND STATUS REPORT

PUBLIC MEETING TO UPDATE THE BOARD ON THE STATUS OF THE PORTABLE FUEL CONTAINER SPILLAGE CONTROL REGULATIONS

MARCH 28, 2000

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STATUS REPORT:

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EXECUTIVE SUMMARY

In September 1999, the Air Resources Board (ARB or Board) approved new regulations for portable fuel containers, commonly referred to as "gas cans." These new regulations include performance standards that will result in the replacement of conventional gas cans and spouts with spill-proof systems (containers and spouts) and spill-proof spouts. The regulations apply to all new gas cans and spouts sold in California starting January 1, 2001, and will provide a 73 percent (over 70 tons per day) reduction in reactive organic gas (ROG) emissions by 2010.

During the September hearing, gas can manufacturers expressed concerns about their ability to meet the proposed permeation standard for plastic portable fuel containers. While the Board approved the permeation standard, they requested the ARB staff provide a status report on the manufacturers' progress towards the development of fully compliant spill-proof systems. This report is in response to the Board's direction.

Staff reviewed the available information and discussed with individual manufacturers their progress in developing spill-proof systems and spill-proof spouts. Several manufacturers have indicated that they will have compliant spill-proof spouts by January 1, 2001. Additionally, the majority of the gas can manufacturers have made significant progress towards complying with all of the adopted performance standards including the permeation standard.

The report includes updated costs estimates for two types of barrier surface treatments that could be used to meet the permeation standard as discussed in staff's original proposal. Two new methods of reducing permeation emissions from plastic gas cans, increasing nominal wall thickness and the use of Selar RB™ are presented for informational purposes. All of the identified options for meeting the permeation standard are within the cost-effectiveness range presented by staff in the original proposal. Therefore, staff recommends the Board determine that no changes to the original rulemaking are necessary at this time.

I. Background

Portable fuel containers, commonly known as "gas cans," have been determined to be a significant source of reactive organic gas (ROG) emissions. Gas cans are used to refuel a broad range of small off-road engines and other equipment. They are normally made of high-density polyethylene (HDPE) (plastic) and are recognizable by their usual bright red color. While the emissions from a single gas can are small, the additive impact of the total number of these containers results in an emission source that contributes significantly to California's air quality problems. Based on recent survey information, it is estimated that there are 9.8 million gas cans in the state. About 1.9 million new gas cans are sold each year in California. According to the 1998 emissions inventory, portable gas cans account for about 87 tons per day (TPD) of smog-forming ROG escaping into California's air. Emissions from this source category will increase to 96 TPD in 2010 if the action taken by the Board last fall to control gas can emissions is not implemented.

In September 1999, Air Resources Board (ARB or Board) approved new regulations for portable fuel containers. Based on performance standards, the new regulations will result in the replacement of conventional gas cans and spouts with spill-proof systems (containers and spouts) and spill-proof spouts. The new spill-proof systems and spouts will virtually eliminate fueling spills by automatically shutting off before equipment fuel tanks overfill. Spill-proof gas cans will remain closed when not in use helping to reduce evaporative emissions from open spouts, as well as eliminating accidental spills. Secondary venting holes will be eliminated under the new standards since these openings also allow venting of gasoline vapors into the air. The new standards also require manufacturers to reduce permeation through plastic containers' walls to no more than 0.4 grams per gallon per day. The regulations apply to all new gas cans and spouts sold in California starting January 1, 2001, and will provide a 73 percent (over 70 TPD) reduction in reactive organic gas (ROG) emissions from gas cans by 2010.

Although there are a few gas cans and spouts on the market that meet many of the performance standards specified in the new regulations, the reduction of permeation from plastic gas cans will likely require the use of some type of barrier applied to the interior of the gas cans. The staff tested two barrier treatment processes, fluorination and sulfonation, and presented results at the September hearing. Both processes have been successfully used on other plastic products to create barriers to permeation. However, incorporating either of these techniques into the manufacturing of gas cans has never been attempted commercially.

To ensure that our air quality goals are met and that progress towards the implementation of the new regulations continues, the Board requested staff provide an update approximately six months after the proposal was approved. This report is an update in response to the Board's direction and includes the progress made by the gas can and spout manufacturers to meet performance standards adopted in September,

particularly the permeation standard. The report also includes updates on the status of the 15-day changes made to the regulations as directed by the Board, and the activities of the ARB staff following the regulatory package development and adoption.

II. 15-Day Changes

As directed by the Board, several changes have been made to staff's original proposal. A notice of public availability of modified text was made available to the public on November 19, 1999. Changes included modifications to fill levels, flow rates, the addition of labeling requirements, and minor changes to two test methods, Test Method 510 (Automatic Shut-Off Test Procedure for Spill-Proof Systems and Spill-Proof Spouts) and Test Method 513 (Determination of Permeation Rate for Spill-Proof Systems). Three manufacturers submitted written comments. Staff has reviewed these comments and has made changes, where appropriate. The complete regulatory package is now being prepared for filing with the Office of Administrative Law.

III. Progress of Gas Can and Spout Manufacturers

To assess the status towards implementing the regulations, staff reviewed available information and had discussions with individual manufacturers. Manufacturers heavily involved in the public process during the development of the regulations have been forthcoming and candid about their progress in developing compliant products. Several have completed designing the spouts and are ready for production. Following the September Board hearing, several entrepreneurs wishing to share prototype designs of new spouts have approached staff. It appears that several manufacturers will have products compliant with the automatic shut-off, automatic closure, one opening, fill level, flow rate, and warranty performance standards in time for the January 1, 2001 effective date. The remaining issue for manufacturers seems to be choosing the most appropriate control strategy to meet the 0.4 grams per gallon per day permeation standard. Therefore, the following discussions focus exclusively on the permeation standard that represents in 2010 control of approximately 8 percent or nearly 8 TPD of ROG emissions associated with gas cans.

A. Permeation – Testing

Several manufacturers are completing initial tests to determine the effectiveness of barrier surface treatments as applied to their products. One manufacturer has tested containers using both fluorinated and sulfonated barrier surface treatments and submitted the results as part of their 15-day comments. These results, using steady state temperature tests and conducted with the assistance of one of the major resin suppliers, indicate that fluorinated containers achieve a significant reduction in average permeation rates. The average rate for all fluorinated containers tested was 0.39 grams per gallon per day with several individual

containers performing significantly better than the adopted permeation standard of 0.4 grams per gallon per day. It should be noted however, that compliance with the permeation standard is determined using a more rigorous variable temperature profile. A higher level of fluorination treatment may be required to comply with the adopted standard when testing is performed using the approved compliance test procedure. The same data set revealed that two of the three sulfonated containers tested failed to offer any significant reduction in average permeation rates, with the third container performing as anticipated with an average permeation rate of 0.14 grams per gallon per day.

Upon further investigation, staff determined that the sulfonated containers submitted for testing were treated at various levels of barrier integrity per the gas can manufacturers request. After contacting the sulfonation processor, staff was informed that the higher treatment level was the only effective way of controlling permeation from plastic gas cans. According to the process manufacturer, these containers performed as anticipated. The higher level of treatment was the basis for staff's earlier recommendations and cost effectiveness estimates.

The remaining gas can manufacturers are in the process of testing various barrier surface treatments and have yet to report results to staff. Data provided by manufacturers to date closely match results of tests previously conducted by ARB staff and presented to the Board in September.

To assist manufacturers in determining an appropriate control strategy for permeation, staff has agreed to conduct follow-up tests of in-line barrier surface treated containers for one of the manufacturers. In-line barrier surface treatment occurs concurrently with the blow-molding process. Containers have been received and are currently undergoing preconditioning. Results of these tests will be presented to all stakeholders. Staff has contacted several other manufacturers to extend this same offer of assistance. By providing the test results to all stakeholders, manufacturers should be able to make a determination of the most effective strategy for their products without resorting to testing every product they manufacture as results are expected to be predictably similar.

B. Permeation - Costs

Staff's initial proposal contained an estimate of the cost of compliance for the adopted 0.4 grams per gallon per day permeation standard. This estimate was based on the application of one of two types of barrier surface treatments, fluorination or sulfonation. Staff originally reported that the cost of compliance for the permeation standard using either of these technologies was projected to be approximately \$0.50 - \$1.58 per container. Several gas can manufacturers testified at the hearing and took issue with these estimates. To assess the outcome of staff's earlier projections regarding fluorination and sulfonation costs, staff again

contacted representatives of the barrier coating processors and developed the following cost estimates.

i. Fluorination

Staff contacted a representative of Fluoro-Seal, who provided a cost estimate of on-site barrier surface treating gas cans using fluorination of between \$0.31 and \$0.36 per gallon of container capacity. This provides the manufacturers with a barrier at level 5, one of the highest treatment levels currently available. Based on high volume, in-house treatment and an average container size of 2.5 gallons, the average cost to fluorinate gas cans in-house is approximately \$0.90 per container.

However, several manufacturers initially may choose to have their containers treated off-site instead of in their own manufacturing facilities. Since the costs associated with off-site treatment are generally higher, this will be used as the basis for determining the average cost to fluorinate gas cans. Fluoro-Seal has an off-site treatment facility located in Ontario, California. According to testimony provided by Bill Brown at the September hearing, Fluoro-Seal can treat gas cans at its Ontario facility at a cost of \$0.37 per gallon of container capacity. Again, assuming an average container size of 2.5 gallons, the average cost to fluorinate gas cans at the Ontario facility is \$0.93 each.

Staff contacted several manufacturers to determine additional costs associated with off-site treatment. Since assembling and packaging the gas cans remains unchanged, the only additional cost would be an increase in product shipping charges. Since most manufacturers are currently shipping conventional gas cans to West Coast distribution centers, the additional shipping charges would be incurred by shipping directly to the treatment site and back to the distribution center. Assuming an average shipping price of \$1.45 per mile per shipment, an average can size of 2.5 gallons (approximately 6000 gas cans per shipment), and an increase in mileage of 1,000 miles (500 additional miles to the treatment facility and 500 miles back to the distribution point), the average increase in shipping per container is approximately \$0.24. This raises the average cost to fluorinate gas cans to approximately \$1.17 per container, which is within the staff's original range of estimated cost.

ii. Sulfonation

Staff contacted a representative of Enviro, Inc., who provided a cost estimate of in-house barrier surface treating gas cans using sulfonation of \$0.55 for a one gallon container, \$0.60 for a two gallon, and \$0.65 for a five gallon container. At the September, 1999, hearing Mr. Tom Schmoyer testified that his company was

prepared to offer sulfonation of gas cans to all manufacturers at a price of approximately \$0.93 per container. According to Mr. Schmoyer, this estimate assumed off-site treatment. The cost differential between off-site and in-house treatment of gas cans is \$0.33. Therefore, Mr. Schmoyer's current estimates for off-site treatment are as follows: \$0.88 for one-gallon cans, \$0.93 for two-gallon cans, and \$0.98 for five-gallon cans. Based on an average container size of 2.5 gallons, the average cost to sulfonate gas cans off-site is estimated to be \$0.95 per container.

However, several gas can manufacturers claimed that unlike fluorination, the sulfonation process lacks the necessary infrastructure to treat a significant amount of gas cans. Staff have investigated this claim and concur. However, Mr. Schmoyer has informed staff that plans have recently been finalized to open a new treatment facility also to be located in Ontario, California. Mr. Schmoyer indicated that the Ontario facility will be operational early this summer and will be able to treat two million gas cans per year per shift. According to Mr. Schmoyer, adding a second shift to the facility can increase its production to four million cans per year, or about twice the amount of gas cans annually sold in California. For off-site treatment costs the average increase for shipping per container would again be approximately \$0.24. This raises the average cost to sulfonate gas cans to approximately \$1.19 per container for off-site treatment.

iii. Certification and Durability Testing

Other costs associated with the permeation standard are those of ongoing certification and durability testing. Manufacturers have indicated that to determine compliance with the permeation standard it will be necessary to perform initial tests on a minimum of six samples of each size and style of container that they manufacture. Staff believes that while this may be true initially, this testing schedule will undoubtedly be relaxed, as results become predictably similar. However, several manufacturers submitted comments during the 45-day public comment period regarding this issue. Included in these comments was a detailed analysis of the costs associated with ongoing certification and durability testing. According to the analysis provided by the manufacturers, on-going certification and durability testing will initially increase costs by \$0.10 per container. This places the final cost estimates to barrier surface treat gas cans using fluorination at \$1.27 per unit and \$1.29 per unit for barrier surface treatment using sulfonation. This falls well within the range of staff's original estimate of between \$0.50 - \$1.58 per container. It should also be noted that these estimates are based on the highest fixed costs staff has identified to date, and may be significantly less depending on the individual manufacturer's processing needs.

IV. Air Resources Board Staff Activities

As previously mentioned, ARB staff has committed to several tasks designed to assist gas can and spout manufacturers in exploring various means of meeting the permeation standard. Along with assisting several manufacturers by performing barrier feasibility tests, staff recently conducted tests to determine the feasibility of developing a correction, or correlation factor, that would allow the manufacturers to use a steady state temperature test in place of the required variable temperature profile. This work is currently underway and staff is awaiting test results from steady state temperature tests performed by both gas can manufacturers and a resin supplier. Staff has also been involved in determining the effectiveness of increasing wall thickness and using alternative materials to HDPE in order to limit permeation. These activities are described below.

A. Effects of Nominal Wall Thickness

Staff conducted tests to determine the effect of increasing nominal wall thickness on average permeation rates from untreated containers. Previous data submitted for review from one of the large resin suppliers suggested that increasing the container wall thickness does mitigate the effects of permeation from plastic containers.

Containers were molded in four different wall thicknesses, from 0.080 to 0.225 inches and preconditioned initially for 12 weeks. Results of gravimetric tests presented in Table 1 show a substantial decrease in average permeation rates as nominal wall thickness increases (Phase I results). To determine if this effect is temporary, staff continued to precondition the same gas cans and again performed gravimetric tests after an additional 12 weeks of preconditioning. After remaining filled with fuel for a total of 24 weeks gravimetric tests still show a substantial decrease in average permeation rates as wall thickness increases (Phase II results).

Data from Table 1 is presented graphically in Figure 1 and compared to the permeation standard. As shown in Figure 1, increasing nominal wall thickness does appear to have a significant effect on average permeation rates of HDPE gas cans. At a nominal wall thickness of 0.225 inches, results suggest that several containers tested could meet the permeation standard of 0.4 grams per gallon per day. Tests are still underway to determine if this provides a permanent solution against the effects of permeation. It should be noted that the compliance test procedure for permeation requires only four weeks of preconditioning. However, there is also a concurrent durability test that has not been performed on these containers.

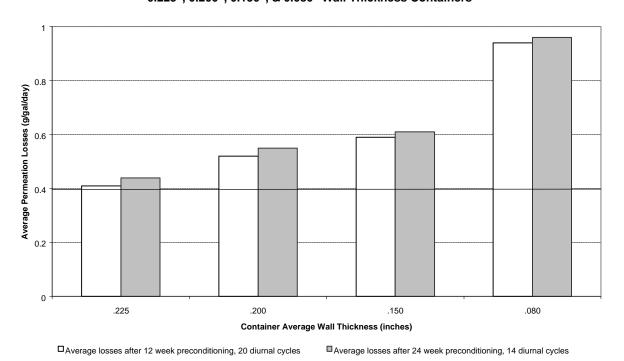
Table 1

Permeation Rates as A Function of Wall Thickness

Phase I (12 weeks)		Phase II (24 weeks)		Overall	
Wall Thickness (inches)	Average Rate (g/gal/day)	Wall Thickness (inches)	Average Rate (g/gal/day)	Combined Average (g/gal/day)	% Difference Phase I vs. Phase II
0.225	0.41	0.225	0.44	0.43	6.8%
0.200	0.52	0.200	0.55	0.54	5.5%
0.150	0.59	0.150	0.61	0.60	3.3%
0.080	0.93	0.080	0.96	0.95	3.1%

Figure 1

Comparision of Permeation Rates vs. Container Wall Thickness 0.225", 0.200", 0.150", & 0.080" Wall Thickness Containers



To utilize this as a means to ensure compliance with the permeation standard, the

data suggest that nominal wall thickness would have to be increased to approximately 0.250 inches. Several manufacturers have indicated that this may be an alternate approach to controlling permeation. According to one manufacturer, an increase in wall thickness to 0.250 inches would represent the upper limit of their production process before problems such as stress cracking and warping threaten to degrade the product. Increasing the wall to 0.250" would necessitate doubling the amount of raw materials per container and decreasing cycle times during production. Both of these changes would mean additional production costs. Another manufacturer indicated that increasing container wall thickness may prove to be an attractive alternative since it causes no logistical problems as found with off site treatment and does not require the installation of any new equipment. Manufacturers that are currently producing heavy wall thickness conventional gas cans could opt for this control strategy at an estimated cost of approximately \$1.50 per container. Costs for those manufacturing lighter and thinner wall cans would be significantly higher as new molds would probably be required. In any case, this option appears to provide several manufacturers with at least an interim means of meeting the permeation standard until a more cost-effective control strategy could be put into place.

B. Selar™

Staff has also identified another means of reducing the effects of permeation by changing the raw materials used to mold gas cans. As previously stated, gas cans are routinely molded from HDPE. DuPont Automotive products makes a barrier resin called Selar RB™ that when mixed in small amounts with the HDPE used to mold gas cans, significantly reduces the effects of permeation. Selar RB™ has been effectively used in automotive fuel tanks to achieve a 98% reduction in permeation as compared to HDPE alone. In addition, this level of permeation reduction can be accomplished while using existing mono-layer blow molding equipment as well as existing molds.

By adding a 4 to 8% concentration of Selar™ in line at the blow molding machine and using controlled mixing of the molten HDPE and Selar™ blend, a tank is produced with many large discontinuous and overlapping barrier platelets within the HDPE structure. This provides an effective barrier that significantly reduces the effects of permeation. Over 1.5 million fuel tanks per year are now in production with Selar™. Assuming an average gas can contains two pounds of HDPE and using the full 8% concentration of Selar™, the cost associated with this type of barrier is \$0.58 per container. Staff has forwarded this information to the gas can manufacturers for their review.

V. Findings, Conclusions and Recommendations

Staff has reviewed the progress that gas can manufacturers have made to comply with the performance standards the Board approved in September 1999. Staff has found that several manufacturers will have products compliant with the automatic shut-off, automatic closure, one opening, fill level, flow rate, and warranty performance standards in time for the January 1, 2001, effective date. The remaining issue for manufacturers seems to be choosing the most cost-effective control strategy to meet the 0.4 grams per gallon per day permeation standard.

Several manufacturers have requested relaxing the permeation standard since the emissions attributed to permeation only comprise approximately 8% of all the total emissions associated with the normal use of gas cans. The manufacturers assert that additional time will lower costs of compliance. The staff originally estimated that the cost of applying one of two available barrier treatments, fluorination and sulfonation would be approximately \$0.50-\$1.58 per container. Upon review of these estimated costs with current information, staff finds the original estimates valid. Staff also found that an infrastructure for off-site treatment is rapidly developing.

Additional testing by staff has identified nominal gas can wall thickening as a potentially viable strategy for achieving the permeation standard at least on an interim basis. Test data indicates that a gas can wall thickness of between 0.225 and 0.250 inches will likely result in compliance with the permeation standard. In discussions with manufacturers, staff found that this approach could readily be taken by some manufacturers at a cost of approximately \$1.50 per container.

A fourth option of mixing Selar™ with HDPE has also been identified by staff. Staff finds this option potentially very cost effective at an estimated cost of \$0.58 per container with minimal capital investment costs.

There is also a sell through provision in the adopted regulations. Any product manufactured before January 1, 2001 may be offered for sale in California for a period of up to one year, provided that the date of manufacture or representative date is clearly displayed on the product. This may provide manufacturers with a means of ensuring they have sufficient products to meet supply during the initial implementation period, while allowing them additional time, if necessary, to develop fully compliant products.

Based on further analysis of the cost effectiveness and technical feasibility of meeting the proposed permeation standard, staff recommends that the Board determine that no changes to the regulations approved in September, 1999, are necessary at this time.